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## IX

# THE KILLIFISH OF SAN IGNACIO AND THE STICKLEBACK OF SAN RAMON, LOWER CALIFORNIA

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Field parties of the Museum of Vertebrate Zoölogy of the University of California have at times collected a few fishes in Lower California. The trout obtained by Mr. Chester C. Lamb in the Santo Domingo River have been reported on by Prof. J. O. Snyder (1926), while the present paper records a stickleback and a killifish obtained by Mr. Lamb in 1925 and 1927. Both have proved of considerable interest, due principally to our very fragmentary knowledge of the fish fauna of the peninsula.

### **Fundulus lima** Vaillant

*Fundulus lima* Vaillant, 1894, p. 71, San Ignatio.
*Fundulus meeki* Evermann, 1908, p. 25, fig. 1, San Ignacio.
*Fundulus lima* Myers, 1927, p. 178.

Two killifishes were collected by Chester C. Lamb at San Ignacio, April 22, 1927. Both are males, the larger in breeding dress.

This is the third occasion on which this fish has been taken at San Ignacio. Vaillant's material was collected "à San

July 15, 1930

Ignatio de Caracamande (centre de la Sierra de la Basse-Californie), dans des bassins et mares de l'ancien établissement des Jésuites" by M. Léon Diguet in 1892. The types of Evermann's *Fundulus meeki* were taken by Dr. E. W. Nelson of the United States Biological Survey "from a small stream flowing from large springs at San Ignacio, Lower California," on October 8, 1905. Mr. Lamb's collection forms the third one from San Ignacio.

The present writer some time ago pointed out (Myers, 1927, p. 178) the identity of *F. meeki* with *F. lima*. Shortly after the appearance of this note, Mr. Carl L. Hubbs *(in litt.)* called the writer's attention to the similarity of *F. lima* and *F. parvipinnis,* the common killifish of the southern California coast, and suggested that the two might not be specifically separable. No material was then at hand, however, and the question was dropped.

Osburn and Nichols (1916, p. 150, fig. 5[1]) have described a deep-bodied race, *Fundulus parvipinnis brevis,* from Magdalena Bay, Lower California. The writer examined the type series of this species in the American Museum of Natural History, New York, several years ago. Comparison with series of *parvipinnis* from San Diego entirely upheld the status given the form by the original describers, for although the depth is in general considerably greater than in *parvipinnis,* some individuals were not to be distinguished from the more northern race by any of the measurements applied.

Unfortunately there are no specimens of *brevis* now at hand for direct comparison with the two *lima* in the present collection. Differences are seen in scale number, which are, however, bridged over by specimens of *parvipinnis*. In general we may say that *lima* shows a tendency towards greater body depth and a more posterior dorsal origin than do the other forms. The depth figures for *lima* are covered by those of *brevis*. Unfortunately Osburn and Nichols do not give the fin positions in their material, and the figure, as has been noted, is not to be trusted. The distances from dorsal origin to snout tip and from dorsal origin to end of hypural given for *lima* in the table are most nearly approached among the small series of *parvipinnis* measured by one which shows .60

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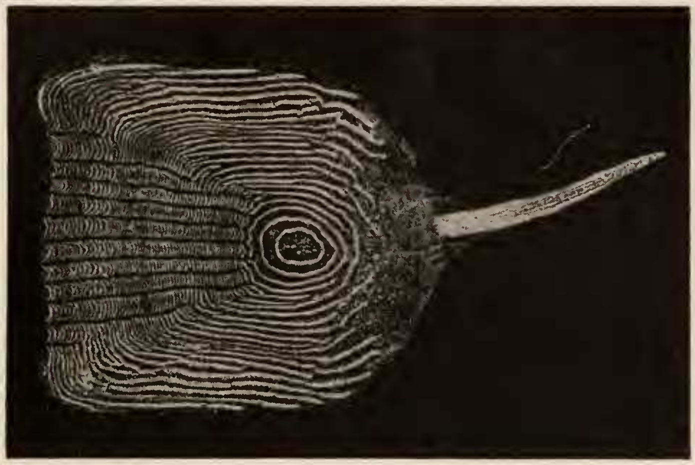
[1] The figure is inaccurate in some of the proportions.

and .42 respectively. (All *parvipinnis* examined are from the coast of San Diego County, Calif.) Since this differs from the *lima* figures only in a very few hundredths, and since our sample of *lima* is so very small, it may be that an adequate series of either will show an overlap.



*Fundulus lima* (Vaillant)

Fig. 1. Scale from peduncle of breeding male *Fundulus lima*, greatly enlarged. The dermal covering of scale and spine has been removed. Photo by Mr. Alan C. Taft.

Another character in which *lima* appears to differ appreciably from related forms is the extraordinary development of the ctenii of the scales of breeding males. These ctenii are known to occur on many killifishes (Fowler, 1916) but the writer knows of no other case where they are so markedly developed. The scales of practically all parts of the body have their free margins edged with one to four small spines, the central one being usually enlarged and the others reduced or absent in the scales of the sides of the body. On the caudal peduncle, from between the dorsal and anal fins to the caudal base, this central spine is enormously enlarged, equalling the exposed portion of the scale in length. Appearing much larger within their thick dermal covering, these projecting spikes give the male a most remarkable appearance. Small prickles are found along the rays of the dorsal and anal fins, these apparently being similar to those of other species of *Fundulus*. The ctenii of the scales are much less developed in the smaller male of the collection.

According to Newman (1909, p. 180) the ctenii or contact organs of breeding males of *Fundulus majalis* and *F. heteroclitus* disappear within eight weeks after spawning, and he believes this to be due partly to wearing off by friction in breeding and fighting and partly to resorbtion. Whether the same is true of the spikes of *lima* we may only surmise.

Males of *parvipinnis* are known to possess scale ctenii at breeding time but in the several small adult males available to me there is no development comparable to that seen in the large *lima*. I can find no description of large adult males of *parvipinnis* in breeding dress.

The principal characters of the two specimens of *lima* are given in the table. The measurements of the relative distances of the dorsal origin from snout tip and from caudal base (end of hypural) are absolute and are not reduced to an ideal horizontal axis of the fish, as are the others. It will be noted that the transverse scale counts given by Vaillant and by Evermann are widely different. While this may be due to Vaillant having counted from the mid-ventral series instead of from the pelvic fin, it is more likely caused by the crowded small scales present at the bases of the anal and dorsal fins in some specimens. Our large male thus has transverse scales 19 while the smaller one has but 16. The scales of the anterior sides of *lima* are very large; posteriorly they grow somewhat smaller, while on the breast and abdomen they are greatly reduced in size. The origin of the anal is a little anterior to the vertical of the dorsal fin origin. The pectorals do not extend quite so far as shown in Evermann's figure, and the pelvics are rather reduced.

The color of the large male is very dark, the whole body being blackish save for a number of scattered light-centered scales. The fins, including pectorals, are blackish with light borders. The smaller male is much lighter and has the typical horizontal dark streak with suggestions of short cross-bands seen on the posterior sides of *parvipinnis*.

Neither of the males shows any tendency towards the production of the elongate anal fin typical of male *parvipinnis,* so well figured by Steindachner (1876, pl. X). This seems to be an important difference, but it may be bridged over by *brevis.*

At the present time it cannot be shown that *lima* and the forms of *parvipinnis* intergrade, although it is possible that they do. The position of the dorsal, the shape of the anal fin of the male, and the peculiar scale formation in this sex must serve as distinguishing characters until more material is available.

*Fundulus lima* is evidently a more or less isolated geographic derivative of *F. parvipinnis,* but whether of the *brevis* or of the *parvipinnis* stock, or of either as they at present exist, we cannot say. Evermann (1908, pp. 20-21) tells us that the stream at San Ignacio loses itself in the sand some 10 to 12 miles from the springs which are its source, but that in rainy seasons it sometimes reaches the coast. Whether at such times it is ascendable by coastal *Fundulus* we do not know. Probably it is not, and the San Ignacio killifish has been isolated for a considerable period.

It would be interesting to have data on the scales of spawning male *parvipinnis,* and on the extent to which this species enters wholly fresh water. Further collections from many localities on the peninsula are necessary before the relationships of *Fundulus parvipinnis parvipinnis* to *F. p. brevis,* and of both to *F. lima* can be clearly ascertained.

### **Gasterosteus aculeatus** (Linnæus)

There are nine specimens of a stickleback collected by Chester C. Lamb at San Ramon, mouth of the Santo Domingo River, on December 26, 1925. All of them possess three plates in contact with the ascending pelvic process[2] but lack all plates behind these as well as the keel of the peduncle. For other data the accompanying table may be consulted.

The sticklebacks, particularly the three-spined ones of the genus *Gasterosteus,* are exceedingly variable creatures. Specimens taken in the Arctic Sea and other northern points are very large, with fully mailed sides and a distinct peduncular keel. Travelling southward, the animals gradually become smaller, begin irregularly to lose their plates, and the keel disappears. Southward they are less and less marine, more estuarian and fluviatile in habits. Those living further upstream tend to have fewer plates, while in at least one stream of southern California, the Santa Ana, almost the whole population is entirely unmailed.

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[2] In specimen VI the third is absent on one side.

Many writers have discussed the variations of West Coast sticklebacks. Rutter (1896) has prepared tables of variations of 2296 specimens from Oregon to "Rio Salado, Mexico." Jordan and Gilbert (1899, p. 443) have discussed variations of Alaskan and more southern material. Evermann and Goldsborough (1907, p. 273) have further discussed Alaskan sticklebacks. Snyder (1908, p. 184) has tabulated variations of numerous individuals from Oregon and northern California.

Regan (1909, p. 437), apparently ignoring this literature, has attempted to show that the naked sticklebacks of the Santa Ana and all to the south,[3] are specifically distinct from the form of the Santa Clara River and all to the north of it. Snyder (1913, p. 71) has shown that in the lack of armature at least, the Santa Ana form is not constant, but up to the present no one (save Jordan and Hubbs, 1925, who give no data) has seriously questioned the adequacy of the vertebral counts used by Regan as his principal diagnostic character.

In the tabulated vertebral counts for the San Ramon sticklebacks the writer has counted the hypural (*i.e.,* the last centrum, with the expanded hypural processes and urostyle) as one. Regan appears not to have included the hypural. The variation from 30 to 32 in five of the San Ramon specimens disposes of Regan's contention that the southern sticklebacks may be distinguished by a reduced number of vertebræ.

There seems no reasonable doubt, however, that Regan's conclusion concerning the specific identity of the stickleback of the North Pacific, *G. cataphractus,* with that of the North Atlantic, *G. aculeatus,* is sound. Jordan and Hubbs (1925, p. 201) propose to recognize three subspecies of Pacific sticklebacks, *G. aculeatus aculeatus* in the far north, *G. a. microcephalus* south of this and along the coast apparently as far south as the species extends, and *G. a. williamsoni* (equals

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[3] Regan, *loc. cit.,* p. 436.

*G. santæ-anæ* Regan) in the Santa Ana River. This arrangement must be supported by a very large mass of evidence before it can be adopted. We have referred above to the fact that, in California at least, the sticklebacks found up-stream are likely to be less completely mailed than those in tide water and this fact alone will necessitate a very careful analysis of the various populations. It must be shown, furthermore, that there are fairly distinct northern and southern groups with a more or less definite area of intergradation instead of an evenly graded series of forms from Alaska southward, before the subspecies *microcephalus* may be accepted. And lastly there is the question of the status of the specimens south of the Santa Ana.

The present material is merely referred to *aculeatus*. Other sticklebacks have been reported from northern Lower California, by Rosa Smith (1884, p. 233) and by C. H. Eigenmann (1892, p. 144), but unless the "Rio Salado" of Rutter is below San Ramon, the specimens of the present collection appear to be the most southerly obtained .

## Note

It apparently has not been noticed that the trout of the Santo Domingo River (see Evermann, 1908, and Snyder, 1926) were first made known through four specimens collected by Edmund Heller in 1902 and recorded by Meek (1904, p. 96) as *Salmo irideus*.

*Fundulus lima*

| Specimen | Standard length | Lengths in hundredths of standard length | | | | | | | Dorsal | Anal | Lat. line |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Caudal peduncle | | Dorsal origin to | | | | |
| | | Head | Depth | Eye | Depth | Length | Snout tip | End hypural | | | |
| I. | 79 mm. | .29 | .32 | .05 | .16 | .22 | .64 | .37 | 11½ | 11½ | 36+3 |
| II. | 63.5 mm. | .30 | .30 | .07 | .15 | .24 | .66 | .36 | 11½ | 12½ | 35+3 |

*Gasterosteus aculeatus*

| Specimen No. | Standard length in mm. | Head length in mm. | H. l. in hundredths of standard length | Dorsal | Anal | Vertebræ, counting hypural |
|---|---|---|---|---|---|---|
| I. | 30 | 10 | .33 | II I 11 | I 9 | 31 |
| II. | 29.5 | 9.5 | .32 | II I 10 | I 8 | 30 |
| III. | 25 | 8 | .32 | II I 11 | I 7 | 32 |
| IV. | 28 | 8.5 | .30 | II I 12 | I 8 | 31 |
| V. | 33 | 10.5 | .31 | II I 12 | I 9 | 30 |
| VI. | 27 | 8 | .30 | II I 12 | I 8 | —* |
| VII. | 27 | 8.5 | .31 | II I 11 | I 9 | — |
| VIII. | 29 | 10 | .34 | II I 12 | I 9 | — |
| IX. | 37.5 | 12 | .32 | II I 12 | I 8 | — |

*Not examined in last four specimens.

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[4] I have been unable to consult the recent work of Bertin on the sticklebacks, Ann. Inst. Océanogr. Monaco, 1925, *2*, pp. 1-204, 71 figs.

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